Fabrication and Use of Flexible Conductive Graphene Paper

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Abstract

There is currently a strong demand for the development of new inexpensive, flexible, light-weight and environmentally friendly paper-like electrode materials. Of special interest are carbon-based paper materials for applications in electrochemical energy storage and sensing devices [1-3]. Graphene with its outstanding structural and physio-chemical properties [4] is a promising building for these types of applications. However, availability in large quantities and processing is limited. Here, sheets of graphene oxide (GO) with its processing, up-scale and reduction possibilities towards conducting graphene-like sheets have emerged as a valuable alternative for the assembly of corresponding graphene paper [5,6].

Here we report the fabrication of flexible conductive graphene paper obtained trough a direct and gentle annealing process of graphene oxide paper. Thermal treatments at 700 ºC under argon or hydrogen atmosphere directly applied to parent graphene oxide paper leads to a significant removal of disruptive oxygen-containing functional groups, and to a considerable recovery of the sp^2 network structure. The resulting highly reduced graphene oxide paper exhibits electrical conductivities as high as 8100 S/m representing an increase of five orders of magnitude with respect to the parent graphene oxide paper, which significantly outperforms results of chemical treatments. Moreover, our direct and gentle thermal reduction allows maintaining the structural integrity and mechanical flexibility of the parent graphene-oxide paper thus overcoming problems of brittleness typically encountered in annealing processes. Our approach is easy and straightforward; and the resulting flexible conducting graphene paper-materials show promise as electrodes for voltammetric sensing applications.

References

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Figures

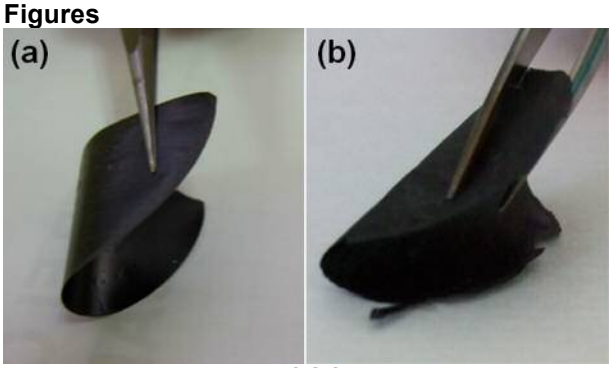

Figure 1: Photographs of GO-paper (a) and graphene-paper (b)

Figure 2: Graphene-paper voltammetric sensing electrode